



Information Paper

Marine Corps Lightweight Helmet Sling Suspension vs. Padded Suspension



Background. The Marine Corps has fielded over 130,000 LWHs for use by most Marines. The Marine Corps' reconnaissance forces, as well as some additional specialized units, utilize the Special Operating Forces developed, Modular Integrated Communications Helmet (MICH) with a padded system to address multiple mission profiles such as parachuting, close quarters combat, and special insertions that expose them to greater risk for non-ballistic impacts. The MICH is the Army's Advanced Combat Helmet (ACH) with a communications package and accepts the tradeoff of less ballistic coverage for increased non-ballistic impact protection and improved situational awareness. The Marine Corps has fielded approximately 2,600 MICH helmets.

Performance. The LWH underwent Initial Operational Testing and Evaluation in 2000 and in 2002 the LWH underwent further Operational Testing and a Field User Evaluation (FUE) which proved its effectiveness in all areas.

Chief among the LWH's overall improvements in effectiveness was the better comfort and fit that comes from its sling suspension system. The improved sling suspension system increased protection, reduced the stress and fatigue of the wearer, and allowed the greatest possible area of coverage. In further testing sponsored by the Marine Corps, Natick Labs conducted an independent test of helmet pad systems. These tests confirmed several negative characteristics of padded systems to include restricted airflow, which increased heat retention, high fluid absorbency rates for sweat and other liquids (POL, DEET, etc), and higher debris retention for sand and other particles resulting in skin abrasions and infections. Also, cold temperature compression testing showed a significant increase in pounds required to compress the pads, which made the pads stiffer and increased wearer discomfort in cold temperatures. It was determined that for longer-term use, the pads could pose health or safety concerns. Accordingly, the sling suspension system was retained for the LWH.

Non-ballistic Impact Testing. The LWH Performance Specification requires protection against non-ballistic impacts, such as is experienced in a pitching combat vehicle, and from falling debris and falls. The specification states that "*the head acceleration upon impact, while wearing the helmet, shall not exceed 200 Gs (threshold), 150 Gs (objective).*"

Comparative non-ballistic impact testing shows that the LWH with a sling suspension yields a head acceleration load of 157 Gs while the USMC Modular Integrated Communication Helmet (MICH), which has the padded suspension system, yields a load of 79 Gs.

This data correlates to recent testing completed at the U.S. Army Aeromedical Research Laboratory (USAARL Report No. 2005-12) where the ACH was compared with the sling suspension system in the PASGT during a series of non-ballistic drop tests. It is key to note that levels of protection change as variables such as temperature and impact velocity change. One example is that at 10 feet per second (FPS) in ambient temperature (~72 degrees), the pads performed significantly better than the sling suspension system. However, at higher temperatures (~130 degrees), such as those experienced in Iraq, the pads' performance degraded significantly (increasing from 75Gs to 131Gs). Though still outperforming the sling suspension system at this velocity, the degradation is noteworthy. When impact velocities increase to 14.4 FPS, and the temperature is increased, the pad degradation increases acceleration load to 411Gs,

or more than 107Gs greater than even the old PASGT sling suspension system. **This environmentally induced pad degradation at higher temperatures is a significant concern.** Recent improvements to the pads are believed to have mitigated this issue. Planned testing in the coming month will determine if this adverse condition remains. In comparison, the sling suspension system performance remained relatively stable (or improved) through the range of temperatures tested.

Mean G Loads				
	10 FPS		14.4 FPS	
	ACH (Pads)	PASGT (Sling)	ACH (Pads)	PASGT (Sling)
Ambient	75	196	203	366
Cold	116	204	164	318
Hot	131	204	411	304

Padded System - LWH Considerations. Improper modification of the design and wear of the LWH by any padded system can place Marines in greater jeopardy. This was highlighted by the US Army and addressed in their Safety of Use message (TACOM SOUM 05-006) which stated that nearly 50% of the soldiers in OIF/OEF are wearing their helmet improperly and also noted that the pads tend to compress over time so additional adjustments to the retention straps are required. Some noteworthy bullets taken from the Army SOUM include:

“In cases where the PASGT or ACH helmets are fitted or worn improperly, the Soldier is exposed to increased risk of injury due to ballistic threats (fragmentation) or concussion.”

“It should be noted that when other items such as headsets, NBC mask, cold weather cap, etc are worn the pads in the ACH will need to be adjusted to allow for the additional equipment. Failure to make adjustments may make the helmet ride too high on the Soldier's head putting the Soldier at greater risk.”

Current Testing. To provide more relevant test data, Marine Corps Systems Command, through the Natick Soldier Center, awarded a contract to the University of Virginia to test helmet acceleration loading during ballistic impacts. The result is a more valid test of the efficacy of any helmet/suspension system under combat conditions. The study has been expanded to also examine the effects of blast. Results of this testing are expected to be available in August 2006.

Bottom-line. After reviewing all available ballistic and non-ballistic test data and human factors considerations, the LWH with a sling suspension system performs equally with the padded suspension system.

The only benefit of pads appears to be non-ballistic impact protection (i.e., bumps, falls, etc.) under some conditions. With this benefit comes additional risk, complexity, and drawbacks such as improper fit, heat and fluid retention, and pad deterioration. There is no evidence that a pad suspension minimizes injury potential in the event of ballistic impact (i.e., fragmentation) which is the primary purpose of the Light Weight Helmet.

Though both suspension systems are approved for use in the LWH, any decision to replace the issued sling system with a padded system must be made with an awareness of the potential drawbacks and dangers that could be incurred if the helmet is not fitted and worn properly or if routine user inspection and preventative maintenance is not conducted.